

V.—On Upper Cretaceous Ammonoidea from Pondoland,

by

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WITH PLATES VI AND VII.

THE Pondoland Cephalopoda, first described by Bailey¹ and Griesbach², were revised by Mr. Woods³ in 1906, and some additional Ammonites, all of the Indo-Pacific type (*Phylloceras*, *Lytoceratids*, *Madrasites*) have lately been recorded by Dr. van Hoepen.⁴ The collection of Pondoland Cephalopoda in the British Museum, referred to by Kossmat⁵ includes further new forms, and in an unfinished MS., the late Mr. G. C. Crick, dealt with most of them. These were briefly mentioned in a paper by the writer on "Cretaceous Cephalopoda from Zululand,"⁶ and comparison there is made between the Umkwelane Hill fauna, also apparently of Campanian age, and the Pondoland Ammonites.

The specimens from the Umzamba Beds of Pondoland here described, form part of a collection made by Mr. E. C. Chubb and Mr. W. J. Plows in July, 1919, and include still a further number of new forms, also some Ammonites, like *A. sugata*, Forbes, and a *Gaudryceras*, resembling *G. sacya* (Forbes) auct., that are of interest on account of their range in time. It must be left for future, careful, zonal collecting to establish, more definitely than is possible at present, that the whole of the 20 feet of Pondoland deposit is of uppermost Senonian age, and that no pre-Campanian beds are present.

1 "Description of some Cretaceous Fossils from South Africa, etc.", Q.J.G.S. Vol. XI, 1855, pp. 454–465.

2 "On the Geology of Natal," Q.J.G.S., Vol. XXVII, 1871, pp. 60–70.

3 "The Cretaceous Fauna of Pondoland," Annals South African Museum, Vol. IV, pt. vii, no. 12, 1906, pp. 275–350.

4 "Description of some Cretaceous Ammonites from Pondoland," Annals Transvaal Museum, Vol. VII, pt. 2, 1920, pp. 142–147.

5 "Jahrb. K. K. Reichsanst," Vol. XLIV, 1894, p. 463; and "Rec. Geol. Surv. India." Vol. XXVIII (1895), pt. 2, p. 42.

6 Annals of the South African Museum, Vol. XII, pt. vii, no. 16, 1921, pp. 217–321, pls. XIX–XXVI.

DESCRIPTION OF SPECIES.

GENUS PHYLLOCERAS, Suess.

1.—PHYLLOCERAS NERA, Forbes sp.

1895. Kossmat, "Untersuch. ü. d. Südind. Kreideform.", pt. i, 'Beitr. z. Pal. & Geol. Ost.-Ung. etc.', vol. IX, p. 160, pl. XVI (II), figs. 2a-d.

An immature example of 20 mm. diameter shews good agreement with Forbe's original (B.M. No. 10472, Geol. Soc. Coll.). Meek's *Ph. ramosum*,¹ and the Antarctic form figured by Kilian & Reboul,² may belong to the same species; but the Patagonian *Ph. nera*, recorded by Paulcke³, is less compressed. '*Schlüteria*' *bodei*, Müller & Wollemann⁴, which, like the other forms, here discussed, is a true *Phylloceras*, with finely divided suture-line, and which is generically different from *Schlüteria*, as here restricted, may be the corresponding, compressed European equivalent of the Indian *Ph. nera*.

Ph. umzambiense, van Hoepen⁵, is a more inflated form, as is *Ph. buchianum*, Forbes sp.⁶, which Kilian & Reboul included in the present group, but which has the typically phylloid saddles of the Barremian-Aptian species of the group of *Ph. thetys*, d'Orbigny sp.

Ph. velledæ, Sharpe, non Michelin sp.⁷ also included in the 'group of *Ph. ramosum*' by Kilian & Reboul, likewise is a more inflated species.

1 Descr. and Illustr. of Foss. fr. Vancouver's and Sucia Islands, etc.", U.S.G. and G. Surv. Terr., Bull. II, 1876, p. 371, pl. v, figs. 1, 1a, b.

2 "Céph. Néocrét. etc.", Wiss. Erg. Schwed. S.-Pol. Exp. III, 6, 1909, p. 9, pl. I, fig. 3.

3 "Ceph. d. Ob. Kreide S. Patagon," Ber. Naturf. Ges. Freib., i, B., vol. XV (1907), p. 169 (3), pl. XIV (V), figs. 5, 5a-c.

4 "Moll. Fauna d. Unterseenon," II, Ceph. Abh. K. Preuss. Geol. L.-A., N. F. 47 (1906), p. 13. pl. viii, figs. 1, 2.

5 Loc. Cit. 1920, p. 142, pl. xxiv, figs. 1-3.

6 "Rep. on Foss. fr. S. Fé. de Bogotá," Q.J.G.S., Vol. I, 1845, p. 177 (B.M. No. 13097 and co-type).

7 "Fossil Mollusca, Chalk of England," I, Ceph. III, Pal. Soc. 1856, pl. XVII, fig. 7 (Mus. Pract. Geol. No. R 7760, Geol. Soc. Coll.).

GENUS GAUDRYCERAS, Grossouvre.

2.—GAUDRYCERAS, sp. juv.

An immature, completely septate specimen, of a diameter of 21 mm., resembles the Antarctic example of *G. politissimum*, Kossmat, figured by Kilian & Reboul¹, but no definite specific determination of the present specimen is attempted. It may, possibly, be the young of *G. amapondense*, van Hoepen², or of *G. cinctum*, Crick MS.³ from the same beds, though the latter has its striation drawn forward very strongly on the periphery. In these forms, and in *G. varagurense*, var. *patagonicum*, Paulcke⁴, the striation, also, is somewhat coarser, whereas the present example, in the fineness of its ornament, resembles Japanese specimens of *G. tenuiliratum*, Yabe, in the British Museum. This latter form, however, is more evolute, as also are *G. pulchrum*, Crick,⁵ and *G. kayei* (Forbes). The suture-line is of the type of those of the Indian forms figured by Kossmat.⁶

The specimen shows considerable resemblance to *G. sacya* (Forbes) that, according to Kossmat, occurs in the Lower Utatur group (Albian) but the holotype of which is associated with *G. buddha*,⁷ *Parapuzosia gaudama* and *Hauericeras? sugata*, all preserved in the same yellowish gritty sandstone. Forbe's original of *A. sacya* has a less depressed whorl-section than the specimen here described, the whorl-height and thickness being 37%, at the diameter of 32.5 mm., whereas in the present example the ratio of H.: Th. = 37: 42. The inner whorls of *G. sacya* also seem to be more loosely coiled ; on the other hand,

1 Loc. cit. (1909), p. 14, pl. I, figs. 7 & 8.

2 Loc. cit. (1920), p. 143, pl. XXIV, figs. 4 & 5.

3 B. M. No. C 19415. Resembling *G. mite* (Hauer).

4 Loc. cit. (1905), p. 6, pl. XVII (VIII), figs. 1 & 2.

5 "Ceph. Trib. Manuan Creek, Zululand," Cret. Foss. Natal, III, 2, Third Report, Geol. Surv. Nat. & Zulul. 1907, p. 237, pl. XV, fig. 1.

6 "Unters. Südind. Kreidef.", I, Beitr. Pal. Ost.-Ung. Vol. IX, 1895, pl. XV, e.g. figs. 6c, 7c.

7 This is a compressed form, comparable with Stoliczka's fig. 7 of pl. lxxv, not with the more inflated varieties: fig. 6, pl. lxxv, or fig. 3, pl. lxxvi. Forbes's holotype (B.M. No. 10484, Geol. Soc. Coll.) has the inner whorls very badly preserved, in crystalline calcite, so that exact comparison with *G. sacya* is difficult; but Stoliczka's fig. 5, pl. lxxv, seems to be somewhat like these slender inner whorls of *G. buddha*. If the various forms of this group are to be included in one species, *A. buddha* has priority, as Whiteaves (Mesoz. Foss. I, IV, 1900, p. 271) has pointed out.

the ornamentation is the same, with very fine striation, strongly drawn forward on the umbilical slope, but straight on the sides and across the periphery, with occasional varices on the cast, and ridges on the shell. The latter are not nearly so conspicuous as those of the New Zealand form figured by Woods.¹ The Japanese example figured by Jimbo² agrees with the present form in fatness and coiling, but has the striation drawn forward laterally and ventrally as well, a feature that suggests that Jimbo's form is more nearly allied to *G. tenuiliratum*, Yabe, or to *G. cinctum*, Crick MS.

The Cenomanian example of *G. aff. sacya*, recorded from Zululand by Crick³ apparently differs very little from the form here described, but increases less rapidly in whorl-thickness. The suture-lines, unfortunately, cannot be compared, Crick's type (B.M. No. C18140) being corroded.

GENUS TETRAGONITES, Kossmat.

3.—TETRAGONITES (?) sp. ind. Pl. VII, fig. 3.

[Cf. 1895. *Lytoceras (Tetragonites) epigonus*, Kossmat, loc. cit. p. 135, pl. XVII, fig. 5].

The immature example, here figured, seems to agree with Kossmat's small specimen, but since it is crushed, and the width of the umbilicus thus is deceptive, the specimen also may be a young *Pseudophyllites*, comparable with Forbes' *A. garuda* (B.M. No. 10462, Geol. Soc. Coll.).

An example from Pondoland, referred to Kossmat's form by Mr. Crick, is in the British Museum (No. C19416) and though more definitely identifiable as a *Tetragonites*, it is only fragmentary.

T. teres, van Hoopen⁴ which greatly resembles specimens of *Pseudophyllites* from Pondoland and from India, has a very high outer whorl, whereas in Kossmat's form, the whorl-height is just a trifle less than

1 "Cret. Faunas of the N. E. Part of the S. Island of N.-Z." N.-Z. Geol. Survey, Pal. Bull. 4, 1917, p. 11, pl. v, fig. 4.

2 "Beitr. z. Kenntn. d. Fauna d. Kreideform. v. Hokkaido," Pal. Abhand. vol. vi, 3, 1894, p. 34, pl. vi, fig. 1.

3 Cret. Foss. Natal, III. "The Ceph. from the Deposit at the N. End of False Bay, Zululand," Third Rep. Geol. Survey, Nat. and Zulul. 1907, p. 170, pl. x, fig. 13.

4 loc. cit. 1920, p. 144, pl. 25, figs. 1, 2.

the thickness. *T. subepigonus*, J. Boehm,¹ also seems close to the present form, perhaps owing to crushing; but in the Pondoland example, the number of auxiliary saddles cannot be determined for exact comparison.

4.—TETRAGONITES aff. CALA, Forbes, sp.

1906. *Tetragonites* sp. aff. *cala* (Forbes), Woods, loc. cit. p. 335, pl. 41, fig. 7.
 1915. *Tetragonites* cfr. *cala* (Forbes) Yabe: "Note on some Cret. Foss. fr. Anaga, etc." Science Rep. Tohoku Imp. Univers. 2nd ser. (Giol.), vol. iv, no. 1, p. 16, pl. i, f. 7; pl. iii, f. 2.

The inner whorls of the present example agree with the slightly more involute specimen figured by Woods, and have one constriction, at a fairly late stage, on the test, and a closely comparable suture-line. There is a fragment of a larger outer whorl (body-chamber) attached, but its mode of preservation is poor.

The Valudayur specimens in the British Museum, including Forbes' and Kossmat's types, have numerous constrictions on the inner whorls, both on the shell and on the cast, whereas in the Pondoland form, the constrictions are not marked on the test, though present on the cast. Otherwise there is perfect agreement with the Pondicherry form.

T. kingianum, Kossmat, var. *involutior*, Paulcke,² is a considerably fatter form.

GENUS PSEUDOSCHLÖNBACHIA, Spath.

5.—PSEUDOSCHLÖNBACHIA PAPILLATA (Crick MS.), Spath.

Plate VI, figs. 2a, b.

1921. Spath, loc. cit. pp. 240 & 242.

The present species is distinguished from *P. umbulazi*, Bailey sp., by being more widely umbilicated and much more coarsely ornamented, the seven prominent umbilical tubercles being present already on the

¹ In Boehm. & Heim.: "Senonbild. d. O. Schweizer Alp." Abh. Schw. Pal. Ges. vol. xxxvi, 1909, p. 52, pl. i, figs. 5 and 10.

² loc. cit. (1905), p. 174, pl. xvii (viii), fig. 4.

inner whorls, and each corresponding with four longitudinally elongated tubercles at the ventro-lateral angle of the ribs.

The dimensions of the figured example are: 63·46·32l·21 : those of a second smaller specimen : 36·46·34·22. Crick's holotype (B.M. No. C19430) has: 71·5·48·30·24 ; and a cotype (C19431): 60·45·28·25. The specimen here figured is slightly crushed.

The suture-line agrees with that of *P. umbulazi*, and there are some transitional forms between the two species.

The Campanian "*Schlænbachia*" *flicki*, Pervinquier,¹ may represent an allied form of *Pseudoschlænbachia*, but the suture-line, apparently, is rather different.

The smaller example is of interest since its slightly notched keel suggests that the form here described as Gen. nov. (*Muniericeras?*) *cricki*, nov. is the direct ancestor of *Pseudoschlænbachia*.

INCERTÆ SEDIS.

6.—GEN. NOV. (*MUNIERICERAS?*) CRICKI, sp. nov. Pl. VII, figs. 4a, b.

This species is based on an example of dimensions : 38·45·40·24. There are eight prominent, umbilical, tubercles, each connected by slightly sigmoidal (discontinuous) ribs with two outer tubercles on the ventro-lateral edges. The roof-shaped periphery has a row of median tubercles, placed in front of the corresponding pair of ventro-lateral tubercles with which they are connected by obscure ribs that form chevrons on the venter (see fig. 4b, pl. VII).

There is close resemblance of this form with the *Barroisiceras* from Madagascar, figured by Boule, Lemoine & Thévenin.² The high tubercles, however, situated on the umbilical edge, even of the inner whorls, as in *Muniericeras lapparanti*, Grossouvre,³ are different from the ornamentation found in the French examples of *Barroisiceras*.

¹ "Ann. d. Crét. Alg.", Mem. Soc. Géol. France, Pal. Vol. xvii, No. 42, 1910, p. 68, pl. vii.

² Pal. Madagascar: "Céph. Crét. de Diego-Suarez.", Ann. de Pal. Vol. ii, 1907, p. 43, pl. xi, fig. 3. (*Schlænbachia* [*Barroisiceras*] *haberfellneri*, Hauer sp.).

³ "Rech. s. l. Craie supér.", II, Mém. Carte Géol. France, 1894, p. 158, pl. xxxv, fig. 3.

P. papillata has similar ornament, and it has been mentioned that the smaller example of this form in the present collection has a slightly notched keel, so that derivation of *Pseudoschlænbachia* from the form here described is suggested, especially since the median row of tubercles is very high and acute in this new form, and may well be assumed to lead to the strong carina of *Pseudoschlænbachia* and *Diaziceras*, which also has similar ornamentation, but a reduced suture-line. *Spheniscoceras* and *Eulophoceras* are further developments of the same stock. An unnamed Egyptian species of *Pseudoschlænbachia*, somewhat intermediate between *P. papillata* and *P. umbulazi* in ornamentation, and with the carina feebly notched, equally forms a connecting link between the new genus here indicated and *Pseudoschlænbachia*.

"*Schlænbachia*" *chicoensis*, Trask sp.¹ may belong to the new genus, and "*Schlænbachia*" *butensis*, Anderson² also from the Upper Chico formation, probably indicates a second, unnamed, development, to which '*S.*' *blanfordiana*, Stoliczka,³ seems allied. The Lower Chico *Barroisiceras?* *siskiyouensis*, Anderson, sp.⁴, however, and its nearly, *B.?* *dentato-carinatum*, Roemer sp.⁵ also greatly resemble the new form, and in the absence of the suture line, no new generic name is given, especially since the Campanian age of this new group may not be considered to be sufficiently firmly established.

GENUS SCHLÜTERIA, Grossouvre, em.

7.—SCHLÜTERIA WOODSI, nov. Plate VII, fig. 1.

This species is represented by the figured specimen (dimensions 85-·56-·40-·07) and an immature example (diameter = 17 mm.), and differs from *S. larteti*, Seunes sp. (Grossouvre)⁶ and from *S. diphyloides*, Forbes sp.⁷ in being more inflated and in having the constrictions

¹ Proc. Calif. Acad. Sci. Vol. I, 1856, p. 92, pl. ii: emend. Anderson, "Cret. Depos. Pacific Coast," ib. 3rd. ser. Vol. ii, Geol. (1902), p. 116.

² loc. cit. (1902), p. 118, pl. iv, figs. 110-11.

³ "Cret. Ceph. S. India," Pal. Indica. Vol. I, 1863, p. 46, pl. xxvi.

⁴ loc. cit. (1902), p. 119, pl. i, figs. 19-20.

⁵ "Kreidebild. v. Texas," 1852, p. 33, pl. i, figs. 2.

⁶ loc. cit. (1894), p. 218, pl. xxxiv, figs. 2 & 3.

⁷ "Report on Foss. Invertebr. fr. S. India, etc.," Trans. Geol. Soc. 2nd ser. Vol. vii (1845), p. 105, pl. viii, fig. 8 (B.M. 10470, Geol. Soc. Coll.).

merely curved forwards, not biconvex. The *Phylloceras* sp. figured by Woods,¹ and compared with *Ph. forbesianum*, D'Orbigny sp. but characterised by *Schlüteria*-ornamentation, with ventral lappets, is not unlike the young specimen, above mentioned, and compared with the typical *S. diphyloides*, figured by Kosmat,² this shews the inflated whorl-section of the early stage of the new form. In the adult, the ventral portion of the whorl is more rounded. As in Seunes's species, the labial ridges of the shell are marked only near the periphery, on the east; the constrictions (beneath the ridges of the test) are continuous on the sides.

The Utatur Ammonite, figured as *A. diphyloides*, by Stolizka³ resembles the present species in its inflated whorl-section, but has far less linguiform ventral lappets, and probably is a *Desmoceras* s.s. (= *Latidorsella*, Jacob.).

The genus *Schlüteria* is here used for the Senonian Desmoceratids that, erroneously, have been included in "Latidorsella." Only, since Grossouvre had originally included in *Schlüteria* certain forms of *Phylloceras* that attach themselves to the group of *P. nera*, Forbes sp., here described, *S. larteti*, Seunes sp. will have to be taken as type of this emended genus *Schlüteria*.

GENUS HAUERICERAS, Grossouvre.

8.—HAUERICERAS? SUGATA, Forbes sp. Plate VI, figs. 3a, b.

1898. *Desmoceras sugata* (Forbes), Kosmat: loc. cit. p. 111, pl. xix, fig. 1.

This well-known form is represented by a completely septate example of 30 mm. diameter, keeled throughout the outer whorl, and having about three of the characteristic, distant, crescent-shaped ridges on the last half-whorl. The Pondoland example differs from the Indian forms, described by Kosmat (but not from Forbes' holotype), in being slightly more inflated (thickness = 46% of the diameter, not 36–42%) and the keel is more distinct than it is in one Valudayur example in the British Museum (C. T. Kaye Coll.), referred

¹ loc. cit. (1906), p. 332, pl. xli, fig. 5.

² loc. cit. (1897), p. 108 (173), pl. xix (xxv), fig. 9a, b. This agrees with Forbes' holotype (No. 10470) and the three cotypes in the B.M.

³ loc. cit. (1865), p. 119, pl. lix, fig. 10.

to by Kossmat, as also in Forbes' holotype (Kaye & Cunliffe Coll., Geol. Soc. No. 10485), whereas a co-type differs very little, if at all, in this respect.

In the Japanese examples allied to *H.? damesi*, Jimbo sp., studied by the writer, the keel is still less distinct than it is in some of the Indian specimens. *H.? loryi*, Kilian & Reboul sp.¹ is a fatter form. The Californian example figured by Anderson,² also, apparently, has a less prominent keel.

As Kossmat³ points out, Forbes' examples of *A. sugata* agree, in matrix, with the holotype of *A. gaudama* (which, in the writer's opinion is much more like '*Puzosia*' *indopacifica*, Kossmat, l.c. pl. xvii, fig. 2, than to '*P.*' *gaudama* (Forbes), Kossmat, pl. xvii, fig. 3), and *A. sacya* and *A. buddha*, Forbes, two 'Utatur' forms, also, are preserved in the same matrix, all labelled *Verdachellum*. This was questioned by Blanford, but for the present purpose it is important to note that the form here described, which was considered, by Kossmat, to be a characteristic fossil of the Upper Trichinopoly group, and which in California also is found in the Lower Chico group, does not occur in the Upper Senonian Valudayur group, though, according to Stoliczka, *A. sugata*, like *Hauericeras gardeni* and various species of *Kossmaticeras* (*Madrasites*) range from the Upper Trichinopoly into the Lower Ariyalur group.

GENUS MADRASITES, Kilian & Reboul.

9.—MADRASITES FAKU, van Hoepen sp.

1920. *Holcodiscus faku*, van Hoepen: loc. cit. p. 144, pl. xxv, figs. 3 & 4; pl. xxvi, figs. 1, 2.

This form is represented by two examples of 75 and 72 mm. diameter respectively.

The holotype of '*Holcodiscus*' *acuticostatus*, Crick MS. (B.M. No. C19433) differs only in having a larger umbilicus (37% instead of 28-29%). '*Holcodiscus*' *natalensis*, Crick MS., has a somewhat similar outer whorl, but more conspicuous tuberculation throughout, and finely striate inner whorls. Both these species, however, are

¹ loc. cit. p. 18, pl. i, figs. 4, 5 (*Desmoceras*).

² loc. cit. (1902), p. 98, pl. iii, figs. 98-9.

³ loc. cit. (1898), p. 116.

extremely close to the present form, which itself is apparently allied to *Madrasites madrasinus* Stoliczka sp.¹

10.—**MADRASITES SIMILIS**, sp. nov. Plate VI, figs. 1a, b.

This species is based on a specimen of dimensions : 100—·38—·33—·34. It differs from *Kossmaticeras sparsicostatum*, Kossmat sp.², which has similar dimensions and the same number of constrictions (five), notably in the presence of prominent, umbilical, tubercles, about twelve per whorl, and in having the costæ recti- to rursiradiate, not prorso-radiate. It stands in the same relationship to *M. faku*, van Hoepen sp., as *Kossmaticeras sparsicostatum* does to the Indian *K. theobaldinum*, Stoliczka sp. The whorl-section is more rounded, ventrally, in the present species, whereas Kossmat's form seems to have the periphery slightly compressed towards the end of the shell. The suture-line is not visible; the terminal portion of the outer whorl belongs to the body-chamber.

11.—**MADRASITES AFRICANUS**, van Hoepen sp.

1920. *Holcodiscus africanus*, van Hoepen, loc. cit. p. 146, pl. xxvi, figs. 3—5.

This species is represented by one example of 21 mm. diameter, agreeing with the type.

The '*Holcodiscus*' sp. figured by Woods³ and which was considered to be close to *Jacobites anderssoni* by Kilian & Reboul,⁴ has a much smaller umbilicus.

GENUS PARAPACHYDISCUS, Hyatt.

12.—**PARAPACHYDISCUS?** sp. nov.? Plate VII, figs. 5a, b.

The figured immature example (dimensions : 30—·46—·40?—·25) and a fragmentary second specimen, that may belong to the same species,

¹ loc. cit. (1865), p. 139, pl. lxx, figs. 1—3.

² loc. cit. (1897), p. 38 (145), pl. vi, fig. 5.

³ loc. cit. 1906, p. 336, pl. xlvi, fig. 2.

⁴ loc. cit. 1909, pp. 62—3. Nothing like the adult *Jacobites* however, seems to have been found in Pondoland.

but is poorly preserved, possibly represents the Puzosid early stage of a *Parapachydiscus*, or at least of one of the groups at present included in that polyphyletic genus, e.g. the North American forms of the group of '*P.* newberryanus' (Meek) Whiteaves, non Gabb, or the South Patagonian '*Pachydiscus*', described by Paulcke.

There are two examples of a new form of such a '*Parapachydiscus*' (*P. umtamfunensis*, Crick MS. sp.) in the British Museum, distinguished from *P. hauthali*, Paulcke sp.¹ only by a more lytoceratid mode of coiling, and agreeing in suture line with *P. amarus*, Paulcke.² The smooth inner whorls of these '*Parapachydiscus*', however, are quite different from the present examples, and in the *newberryanus*-group, the inner whorls are too strongly ornamented.

In side-view the ornament of the present examples resembles that of '*Holcodiscus*' *pondicherryanus*, Kossmat,³ which is neither a *Parapachydiscus* nor a *Kossmaticeras*, but belongs to a Puzosid stock that also includes '*Puzosia*' *japonica*, n.n. = *Desmoceras gaudama*, Yokoyama, non Forbes,⁴ and *P. darwini* (Philippi in Steinmann) and which is intermediate between *Parapuzosia* and *Kossmaticeras*.

The present species has a more rounded whorl-section, suggestive of the constricted *Parapachydiscus*, above referred to. It is distinguished from young *Kossmaticeras* and from '*Holcodiscus*' *pondicherryanus* by the ornament appearing first on the venter, and not on the lateral area, and from *Parapuzosia* by its straight constrictions.

GENUS HOPLOSCAPHITES, Nowak. em.

13.—HOPLOSCAPHITES, sp. juv.

An immature, completely septate example of a '*Scaphites*' of a diameter of only 14 mm., has a more compressed whorl-section than the form figured by Woods⁵ and the ribs are strongly flexiradiate; but the suture-line, with bifid lobes and saddles, shews similarly rounded, terminal folioles, suggestive of simplification. The first

1907
1 loc. cit. 1905, p. 233, pl. xix, fig. 2.

2 ib. text-fig. 29 on p. 62.

3 loc. cit. 1907, p. 40, pl. vi, fig. 6.

4 "Verstein, a.d. Japan. Kreide.", Palaeontographica, vol. 36, 1890, p. 184, pl. xix, fig. 5.

5 loc. cit. (1906), p. 343, pl. xliv, fig. 8.

lateral saddle is comparable with that of *H. tenuistriatus*, Kner sp., in Nowak,¹ but the umbilical portion of the suture-line is as simple as it is in the dwarf-form of *H. constrictus*, Sowerby, figured by the same author.²

'*Scaphites*' *gillisi*, Anderson,³ has a suture-line similar to Woods' example, but in the present form, the external saddle is not so wide, and more like that of the American group of *H. nodosus*, Owen sp., as figured by Meek.⁴ *H. constrictus* (Sowerby) d'Orbigny sp.⁵ with similar inner whorls, has a more deeply indented suture-line. *H. constrictus*, var. *quiriquinensis*, Wilckens,⁶ though very similar to the Pondoland example in external appearance, also has a different suture-line.

Yezoites planus, Yabe,⁷ also has comparable inner whorls, but its suture-line has a wider external saddle.

The Campanian *Hoploscaphites* of the *constrictus*-group here considered, may be developments of 'Pachydiscus' of the type of '*P.* menu', Forbes sp., with simplification of the suture-line, and they are excluded from the hoplitid *Scaphitidae* of the Middle Cretaceous. *Anascaphites*, *Discoscaphites*, *Yezoites*, and some *Acanthoscaphites*, probably also have to be attached to the family *Desmoceratidae*.

GENUS OXYBELOCERAS, Hyatt.

14.—OXYBELOCERAS? CF. QUADRINODOSUM, Jimbo. sp.

Pl. VII, figs. 2a, b.

1894. *Hamites quadrinodosus*, Jimbo. "Beitr. z. Kenntn. d. Fauna d. Kreidef. v. Hokkaido." Pal. Abh. N. F., Vol. II, Heft 3, p. 39, pl. vii, figs. 3 & 4.

1 "Untersuch. Cephalop. Ob. Kreide Polen.", II, Skaphiten. Bull. Ac. Sci. Cracovie, July 1911, fig. 17 on p. 583.

2 ib. fig. 18 on p. 587.

3 loc. cit. (1902), p. 110, pl. iii. figs. 85–8.

4 "Inv. Cret. & Tert. Foss. of Up. Missouri Country," in Hayden U.S. Geol. Surv. of Territ. 1876, pl. 25.

5 Pal. Franç. Ter. Crét. (1840), pl. 129, figs. 8–11.

6 In Steinmann: "Beitr. z. Geol. & Pal. v. S.-Am." XI: "Revis. d. Fauna d. Quiriquina-Sch." N. J. f. Min. etc. Beil. B. XVIII, 1904, p. 189, pl. xvii, figs. 3–8.

7 "Seaph. v. Hokkaido." Beitr. Pal. Geol. Ost.-Ung. Vol. 23 (1910), p. 167, pl. xv, fig. 15 only.

TABULAR LIST OF PONDOLAND AMMONOIDEA
WITH OCCURRENCES OF IDENTICAL (X) OR COMPARABLE (A) SPECIES IN OTHER DEPOSITS.

Number	Species.	Page	Zululand	Madagascar	India	Tunis	S. Patagonia	Antarctica	California	Vancouver	Hokkaido
			Valdahayur	Trech. and Araval	Egypt		Quiriquina				
1	<i>Phylloceras nera</i> (Forbes).....	40	A	X		X	X	A	X	A	
2	" <i>umzambiene</i> , v. Hoepen.....	40					A				
3	<i>Gaudryceras cinctum</i> (Crick MS.) Spath.....	41	A	A	A				A	A	
4	" <i>amapondense</i> , v. Hoepen.....	41	A						A		
5	" <i>kayei</i> (Forbes).....	41	A	X	X	X	X	X	X		
6	" sp. juv.....	41	A	A	A	A	A	A	A	A	
7	<i>Tetragonites</i> (?) sp. ind.....	42	A	A					A	A	
8	" <i>aff. cala</i> (Forbes).....	43	A	A	A	A	A	A	A		
9	" <i>teres</i> , v. Hoepen.....	42					A				
10	<i>Pseudophyllites indra</i> (Forbes).....			X	X		X		X	X	
11	<i>Pseudoschäenbachia umbulazi</i> (Baily).....	43	X		A						
12	" <i>giesbachi</i> (Crick MS.) Spath.....										
13	" <i>papillata</i> " "	43		?	A						
14	Gen. nov. (<i>Muniericeras?</i>) <i>cricki</i> , nov.....	44	?				?				
15	<i>Eulophoceras natalense</i> , Hyatt.....										
16	<i>Spheniscoceras africanum</i> (Crick MS.) Spath.....										
17	" <i>tenue</i> "										
18	" <i>minor</i> " "										
19	<i>Mortoniceras soutoni</i> (Baily).....		A		A						
20	" <i>strangeri</i> " "			A							
21	" sp. ind. (Crick MS.).....				A						
22	<i>Schlüteria woodsi</i> , nov.....	45		A	A	A		A	A		
23	<i>Hauericeras gard-ni</i> (Baily).....	47		X	X	X		X	X		
24	" <i>rembda</i> (Forbes).....			X	X	X					
25	" ? <i>sugata</i> " "	46		X		A	X	X			
26	<i>Madrasites faku</i> (v. Hoepen).....	47		A		A					
27	" <i>acuticostatus</i> (Crick MS.) Spath.....	47		A		A					
28	" <i>natalensis</i> " "	47		A		A					
29	" <i>similis</i> , nov.....	48		A		A					
30	" <i>africanus</i> (v. Hoepen).....	48	A	A		?	A				
31	" sp. ind. (Woods).....						A				
32	<i>Parapachydiscus?</i> sp. nov.?				A	A	A	A	A	A	
33	" <i>umtamfunensis</i> (Crick MS.) Spath	49			A				A		
34	" sp. ind.....			A	A	A	A	A	A	A	
35	<i>Hoploscapites</i> sp. juv.....	49		A	A	A	A	A	A	A	
36	" sp. ind. (Woods).....			A	A	A	A	A	A	A	
37	<i>Bostrychoceras?</i> sp. (Woods).....		X	A	A			A		X	
38	" sp.		X	A	A			A			
39	<i>Diplomoceras? indicum</i> (Forbes) Woods.....		X	A	A	A	X	X	X	A	
40	" sp. (Woods).....		X	X	A	A	X	X	X	A	
41	<i>Oxybeloceras</i> cf. <i>quadrinodosum</i> , Jimbo.....		X	A	X	A		A	A	A	
42	<i>Noerioceras</i> cf. <i>spinigerum</i> , Jimbo.....	52							A		
43	<i>Baculites capensis</i> , Woods.....		X	A	A	A	A	A	A		
44	" <i>sulcatus</i> , Baily.....		X		A		A				
45	" <i>bailyi</i> , Woods.....		X	A	A	A					

The figured fragment, consisting of a septate, straight portion of only 15 mm. length, differs from the 'young form' (fig. 4) of Jimbo in having less oblique and fewer costæ; but a beautiful example from the Umzamba Beds of Pondoland, belonging to the Geological Survey, Cape Town, and kindly sent to the writer by Mr. Henry Woods, with the hook well-preserved and two straight arms of 230–250 mm. length, is closely comparable with Jimbo's type (fig. 3). '*Hamites*' *interruptus*, Schlüter,¹ also is comparable and, perhaps, less so, '*H.*' *wernickei*, Wollemann,² the latter also recorded from Tunis.³

The double row of ventral tubercles and the single costæ are reminiscent of *Oxybeloceras crassum* and *O. meekanum*, Whittlefield sp.⁴ *O. mortoni* Meek,⁵ and *O. liniatum*, Gabb.⁶, but the fragment is too small to permit of correct generic identification.

The genus *Oxybeloceras* is here taken to include forms of ptychoceran coiling as well as hamitids and crioceracones, e.g. '*Ancyloceras*' *bipunctatum*, Schlüter.⁷

GENUS NEOCRIOCERAS, nov.

Genotype: N. cf. *SPINIGERUM*, Jimbo sp., p. 52. Plate VII, fig. 6c.

The helicoid example, figured on plate VII, fig. 6, is here taken as type of the new genus, though its simple suture-line is not distinctly traceable and its whorl-section, on account of crushing, is not recognisable. The Japanese example, however, though it is in a better state of preservation, might conceivably be a true Cenomanian *Anisoceras*, and it may be recalled here that the older German authors had erroneously recorded Sowerby's '*Anisoceras armatum*' from the *Marsupites*-zone. The ornamentation is similar in the two genera.

¹ "Cephalop. d. Ob. Deutsch-Kreide." Pal. Vol. 24 (1876), p. 105, pl. xxxii, figs. 8 & 9.

² "Die Fauna d. Lüneburger Kreide," Abh. K. Preuss. Geol. L.-A., N. F. Heft 37 (1902), p. 95, pls. iv. & v.

³ Pervinquière: Pal. Tunis. I, Céph. Terr. Second, 1907, p. 86, pl. iii, fig. 33.

⁴ "Geology of Black Hills of Dakota," U.S.G.G. Survey (1880), p. 457–9, pl. xvi, ff. 1–2 and 3–6. *figs. 3–6 are* *in* *the* *Pyramids*

⁵ loc. cit. (1876), p. 412, pl. 20, figs. 4a–c.

⁶ Pal Calif. Vol. II (1869), p. 139, pl. 23, fig. 18.

⁷ loc. cit. Pal. Vol. 21 (1872), p. 98, pl. xxix, figs. 1–3.

The Pondoland form here described, has first one, then two, then three fine intermediate ribs between the tuberculated stronger ribs. The latter, at an early stage, break up into two finer ribs of the strength of the intermediaries, but at the four tubercles, two of which are ventral, and two lateral, they unite in the button and loop style (fibulation) characteristic of *Peronoceras*. On the dorsal area, all the ribs are continuous and of equal strength.

Some Turonian *Hyphantoceras?* (e.g. *Hamites multinodosus*) Schlüter¹ or *Heteroceras ceratopse*, Anderson², have a somewhat similar appearance, but the suture-line of *Hyphantoceras* is much more complex than that of the present Upper Senonian stock which apparently is related to the genus last described (*Oxybeloceras*). The new genus, apparently, stands in the same relationship to *Nostoceratidae*³ (e.g. *Exiteloceras*), as *Anisoceras* does to *Turrilitidae* (*Pseudhelicoceras robertianum*, d'Orbigny, sp.).

It is probable that '*Ancylloceras*' *pseudo-armatum*, Schlüter⁴, from the *mucronata*-Chalk represents an adult whorl-fragment of a form of the new genus.

15.—NEOCRIOCERAS cf. SPINIGERUM, Jimbo sp. Plate VII, figs. 6a-c.

1894. *Crioceras spinigerum*, Jimbo, loc. cit. p. 38 (184), pl. viii, figs. 1, 1a, b.

The form here figured (type : fig. 6c) differs from Jimbo's presumably Upper Senonian species in having the costation radial, not inclined forwards, also apparently in cross-section. The outline-section of fig. 6c is given to shew the helicoid coiling, but the whorls are crushed ; the other two fragments, also, are compressed, apparently accidentally, whereas the Japanese species is depressed. In spite of the crushing, however, the whorl-section of the large fragment (fig. 6a) is nearly circular ; all the three examples are septate throughout. The suture-line appears to be of the same simple type as that of the Hokkaido form.

1 loc. cit. p. 106, pl. 32, figs. 1 & 2.

2 loc. cit. (1902), p. 91, pl. iii, figs. 100-1.

3 Not related to *Cosmoceratida* or the other families with which Hyatt (in Zittel-Eastman) had united it.

4. loc. cit. p. 164, pl. 43, figs. 8 & 9 (5-7?).

CONCLUSIONS.

The forty-five Ammonoidea, described up to the present from Pondoland, are listed below and it will be seen that they mostly are comparable or identical with forms that occur in the well-known Upper Senonian (Campanian + Maestrichtian) deposits of the classical areas, e.g. apart from those mentioned in the table, the Charente, Dordogne and the Cotentin of France, or Nagórzany in Poland, whence *A. sulcatus* had been described by Kner before the closely similar *Hauericeras gardeni*, the commonest Pondoland Ammonite, was made known by Bailey. Mr. Woods has drawn attention to the close resemblance that exists between the Pondoland fauna and those of the Ariyalur and Valudayur groups of Southern India. The Kaye & Cunliffe Collection in the British Museum, from the Valudayur beds of Pondicherry in Southern India, studied by Kossmat and correlated with the Lower Campanian by Pervinquier, includes, in addition to Forbes' types of *Hauericeras rembda* (+ *durga*), which is almost identical with the young of the Pondoland *H. gardeni*, also *Phylloceras nera*, *Gaudryceras kayei*, *Tetragonites cala* and *T. epigonus*, *Pseudophyllites indra*, *Schlüteria*, *Hoploscaphites*, *Bostrychoceras*, and *Diplomoceras*, all found in Pondoland. On the other hand, typical *Brahmaites*, *Sphenodiscus*, and *Parapachydiscus* of the *egertonii-crishna*-type, comparable with the European *gollevillensis-neubergicus* group, are absent in Pondoland, whereas not a single *Kossmaticeras* or *Madrasites* is found in the Valudayur Beds of Southern India, '*Holcodiscus*' *pondicherryanus*, Kossmat, referred to before, being intermediate between *Parapuzosia* and *Parapachydiscus*, and '*Holcodiscus*' *indicus* (Forbes) Kossmat, probably being a fragment of a *Hoploscaphites* of the *nodosus*-group.

When comparing the Umkwelane Hill fauna of Zululand, which also consists mostly or entirely of Campanian types, with the Pondoland fauna, the writer drew attention to the fact that they only had in common one single Ammonite species (*Pseudoschlaenbachia umbulazi*) and a limited number of uncoiled and straight forms; also that *Hauericeras gardeni*, represented in the Pondoland collection in the British Museum by no less than 37 examples, was unknown from Umkwelane Hill, as were the stenothermal genera *Phylloceras* and *Lytoceras* (s.l.). Yet the hard shelly limestone of Umkwelane Hill is almost indistinguishable from the matrix of Forbes' Valudayur types, though the resemblance of the Indian fauna is so much greater with that of Pondoland, preserved in a soft glauconitic sandstone.

The numerous 'Kossmaticeras' of Pondoland all belong to *Madrasites*, found only in the Upper Trichinopoly and Lower Ariyalur groups; and the abundance of these *Madrasites* is a notable feature of the Upper Senonian deposits of Antarctica and New Zealand. Another form, unknown in the Valudayur group, is *Hauericeras?* *sugata*, according to Kossmatt, a characteristic fossil of the Upper Trichinopoly group, and in California, also, occurring only in the Lower Chico group. In India, this form is said to be associated with *Madrasites bhavani* (Stoliczka), *Placenticeras tamulicum* (Blanford), *Peroniceras dravidicum* (Kossmat), and other Upper and Lower Senonian species that are identical with, or resemble, Zululand forms described by the writer; and the occurrence of the Coniacian in Zululand, as in Madagascar, is undoubted. It may then be assumed that Desmoceratids of the type of *A. sugata*, Forbes, have a fairly wide vertical range. One of the forms, here described, namely *Gen. nov. (Muniericeras?) cricki*, nov., equally, greatly resembles a Lower Senonian "*Barroisiceras haberfellneri* (Hauer)" described from Madagascar, also *Muniericeras lapparanti*, Grossouvre, and *M. gosaicum* (Hauer), though comparable species are known from the Californian Upper Chico beds. Finally, an immature specimen of a *Gaudryceras* is almost indistinguishable from *G. sacya* (Forbes) auct., recorded already from Zululand, Condicia and Madagascar, and associated in Forbes' original collection (C. T. Kaye Coll. from Verdachellum) with *G. buddha*, *Parapuzosia gaudama* and *Hauericeras?* *sugata*, all preserved in a yellowish gritty sandstone, very different from the matrix of the Valudayur specimens in the Kaye & Cuncliffe Collection. When the writer first saw these doubtful examples in the present collection, at the time of completion of his paper on the Cretaceous Cephalopoda of Zululand, he felt justified in inserting a note to the effect that this new collection from Pondoland included forms possibly of pre-Campanian age, and that the collection arrived just in time to prevent the usual error of considering the beds to belong to one formation, simply because the great majority of forms were of Campanian age. On reconsideration, however, and taking into account the fact that Senonian forms of *Gaudryceras*, very similar to *G. sacya*, are known, it would appear that the new evidence is not inconsistent with the assumption of an Upper Senonian (Campanian + Maestrichtian) age for the whole of the Pondoland fauna; and it has to be remembered that according to Woods, the Upper Campanian or Maestrichtian *Pseudophyllites indra* occurs in the basement bed of the Pondoland deposit. The presence of non-sequences, of course, in

perfectly homogeneous deposits, now found to be fairly frequent, should be a warning against assuming contemporaneity of such diverse faunal elements as those here dealt with, and the three divisions of the Campanian and two zones of the Maestrichtian in Haug¹ probably represent only part of the true succession of horizons. Equally great difficulties of correlation, unfortunately, are experienced in other comparable areas, e.g. Kilian & Reboul point out that *Madrasites* spp., *Hauericeras?* *sugata*, *Gaudryceras varagurense* and *Tetragonites epigonom* appear in the Upper Trichinopoly beds and that it was just this assemblage of species [all found in Pondoland] that characterised their Snow Hill beds. They add "It follows from these comparisons that the Cretaceous formations of the Islands Snow Hill and Seymour, as a whole, exactly correspond, by their faunistic characters, to the Senonian (sensu-lato = Santonian-Maestrichtian) of the Trichinopoly district of India with which they can be synchronised."

It should be added here that though the Pondoland *Madrasites* bear a closer resemblance to the tuberculate Antarctic forms, they are not identical with either these or the Trichinopoly species.

From the list it will be seen that the fauna also is closely comparable to that of Tunis, whereas a difference of facies, in Egypt, results in the absence, there, of the typical Lytoceratids, so common in the other areas. On the other hand, in circum pacific regions, notably in Japan and California, the number of identical or comparable species is quite considerable. Unfortunately, in these regions, also, no zonal collecting appears to have been done, and, as mentioned before, the ranges of such doubtful forms as the keeled Desmoceratids and *Gaudryceras* in Japan, or of the many '*Schlænbachia*' in California, have yet to be established.

A point of palaeogeographical importance may here be noted. When discussing the difference between the "Atlantic" facies of the Umkwelane Hill fauna, and the "Indo-Pacific" character of the Pondoland deposit, the writer was of opinion that the occurrence of *Nostoceratidae* in Zululand pointed to an introduction of these "Atlantic" elements from the North, comparable forms, then, being known only from Egypt, Europe, North-America and Japan. The resemblance of the Umkwelane Hill deposit with the Egyptian uppermost Cretaceous was enhanced by the occurrence there of a form of *Pseudoschlænbachia*, and the abundance of *Baculites*, in addition to other uncoiled forms, whereas *Mortoniceras* of the *delawareense*-type,

¹ *Traité de Géologie*, vol. ii, fasc. 2, p. 1170.

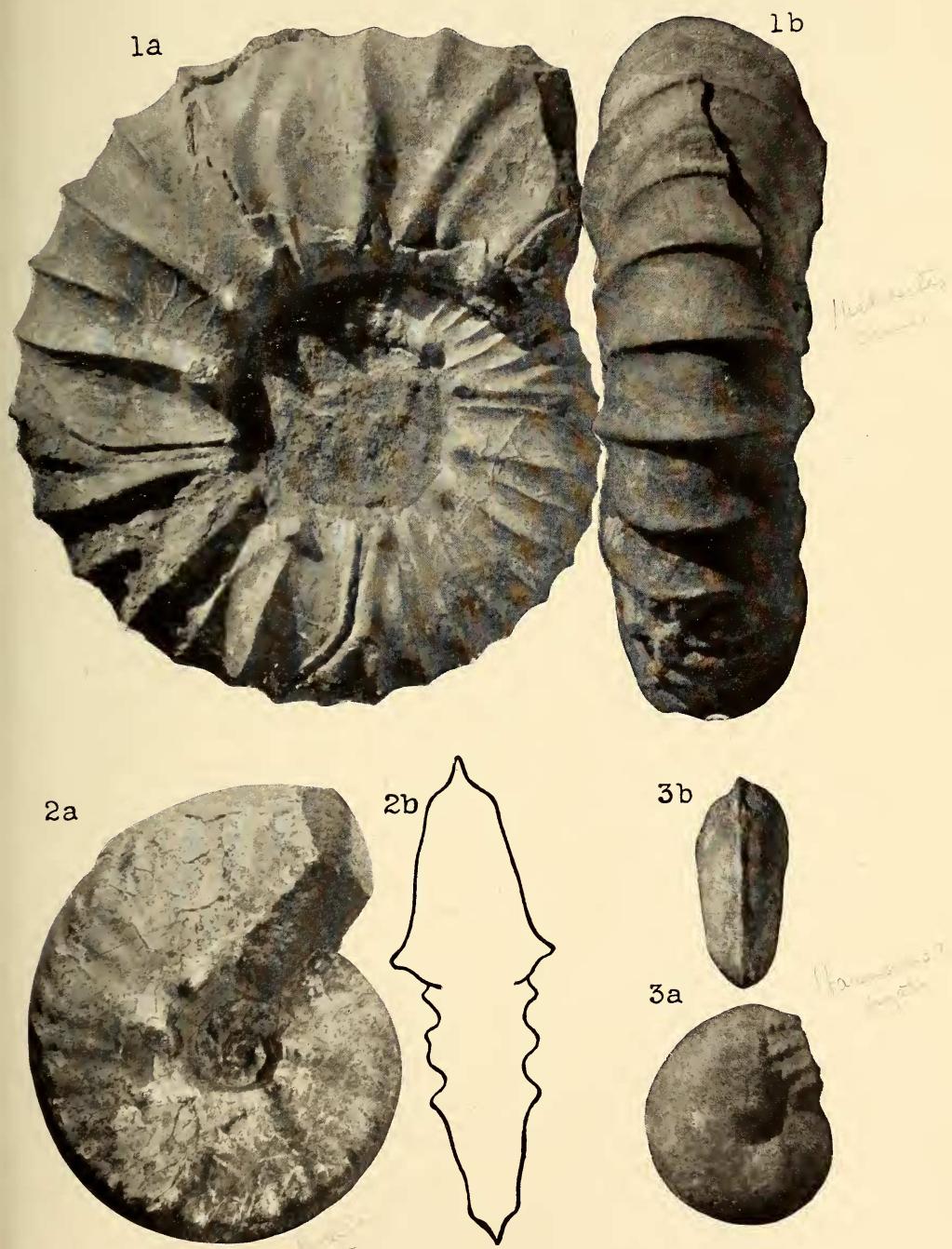
allied to the South African *Mortoniceras soutoni*, Bailey sp. and *M. woodsi*, Spath, had been described from Tunis. Since then, through the kindness of Mr. Beeby Thompson, the writer has been able to examine a small collection of *Nostoceratidæ* [*Didymoceras* of the type of *D. nebraskense-cooperi* (Meek) and *D. hornbyense* (Whiteaves)] from the Barra do Dande, Angola, whence Choffat¹ had described an *Inoceramus* of unknown age. This seems to be the first record of Campanian Ammonoïdes from the West Coast of Africa; for Lang's 'cornes d'Ammon' mentioned in 1839² apparently are lost, and Welwitsch³ later classed the rocks at Dande as "Muschelkalk."

The writer, however, still believes that the great transgressing Campanian Sea, that invaded the whole of Northern Africa, from Senegal, via the Knee of the Niger, and Bilma in the Sudan, to Egypt, reached the most Southern locality, Dande, in a separate arm to the West, and that there was no marine connection between Angola and South Africa and Madagascar in the East, via the Cape. The Turonian and Coniacian faunas of Nigeria and the Cameroons indicate that the Western Arm of the Thetys, down to Angola, probably existed continuously from Albian times.

¹ Contrib. Connaiss. Géol. Col: Portug. d'Afr. II, Nouv. données s.l. z. littorale d'Angola Comm. Serv. Géol. Port. 1905, pp. 10 & 42, pl. i, fig. 1.

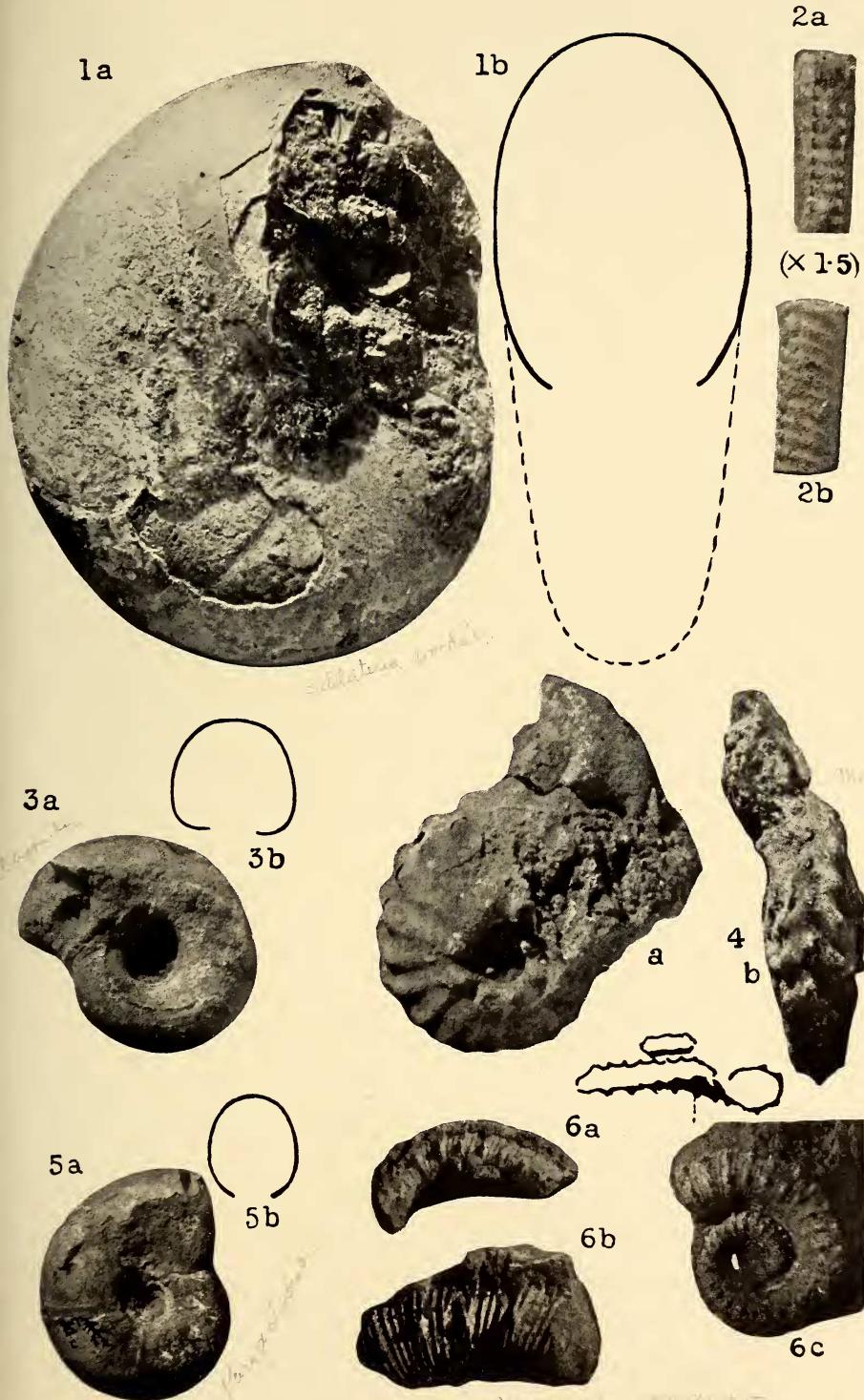
² "O petroleo do Dande, 1839." Apparently not published till 1886 (Bol. Soc. Geogr. Lisboa, 6th ser. no. 4, pp. 240-9).

³ "Quelq. Notes s.l. Géol. d'Angola, etc." Communicações, vol. ii, 1888.



UPPER CRETACEOUS AMMONOIDEA FROM PONDOLAND.

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UPPER CRETACEOUS AMMONOIDEA FROM PONDOLAND.

EXPLANATION OF PLATES VI & VII,

Illustrating paper by L. F. Spath on
"Upper Cretaceous Ammonoidea from Pondoland."

PLATE VI.

Ammonites from the Upper Senonian Umzamba Beds of Pondoland.
All the figures are of the natural size.

1a, b. *Madrasites similis*, sp. nov.
Side- and peripheral-views.

2a, b. *Pseudoschloenbachia papillata* (Crick MS.), Spath.
Side-view and Sectional outline; specimen slightly
crushed.

3a, b. *Hauericeras? sugata*, Forbes sp.
Side- and Peripheral-views.

PLATE VII.

Ammonites from the Upper Senonian Umzamba Beds of Pondoland.
All the figures, with the exception of 2a, b, are of the natural size.

1a, b. *Schlüteria woodsi*, sp. nov.
Side-view and sectional outline.

2a, b. *Oxybeloceras?* cf. *quadrinodosum*, Jimbo sp.
Ventral- and lateral-views, enlarged.

3a, b. *Tetragonites?* sp. ind.
Side-view and outline whorl-section.

4a, b. Gen. nov. (*Muniericeras?*) *cricki*, sp. nov.
Side- and peripheral-views.

5a, b. *Parapachydiscus?* sp. nov.?
Side-view and outline whorl-section.

6a, b, c. *Neocrioceras* cf. *spinigerum*, Jimbo sp.
Views of two fragments (6a, b) and of helicoid early
whorls (6c, seen from below) with sectional
outline. 6c slightly crushed.